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**FAUNAL AND BIOLOGICAL STUDIES ON THE INSECTS OF PADDY  
FIELDS IN ASIA. IV. AQUATIC AND SEMIAQUATIC  
HETEROPTERA FROM THE PHILIPPINES<sup>1)2)</sup>**

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**Abstract**

Aquatic and semiaquatic Heteroptera collected from the Philippine paddy water in **1979** are enumerated. A total of 17 species (717 specimens) belonging to 11 families are listed with notes including 2 new species, *Paraplea davaoensis* Miyamoto (Pleidae) and *Anisops yanoi* Miyamoto (Notonectidae). Previous records of these bugs from the paddy water of the world are also reviewed.

Aquatic species of Heteroptera dwelling in paddy fields have hardly been accorded any attention in insect pest control which has been carried up to the present in the rice areas of the world. Fragmental records on their occurrence in paddy water, however, have been presented. Yet no extensive works have been done before anywhere else. Several papers such as Moretti (1932) in Italy, Fernando (1959) in Sri Lanka, Service (1973, 1977) in Kenya, Heckman (1974, 1979) in Laos and Thailand and Polhemus and Reisen (1976) in the Philippines reported around 15 species from the respective localities, and these are the prominent ones among the papers concerned. Among the species concerned, *Microvelia* species may be the only exception to have been observed by several authors as predators of plant- and leafhoppers in paddy fields. Aquatic fauna of paddy water covering fishes and other animals including insects, however, have been reported by Fernando (1956) and others. It is still true that the aquatic insect fauna of the environment has not been

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focussed well on Heteroptera as stated above,

During the field surveys on the plant- and leafhoppers injurious to rice and their natural enemies made in the Philippines in 1979 (Hirashima, 1981), aquatic and semiaquatic Heteroptera found in paddy water were collected by the first author in co-operation with the third author, and identified by the second author who is also responsible for the descriptions of new species. It is known that these groups of Heteroptera are mostly predaceous and feed on various insects including plant- and leafhoppers. The work has been done consequently along the purpose of the project and as planned by the first author (Yano, 1978). Though the collection is not big and informations on the biology were scarcely obtained, the result is enumerated here for further studies with a bibliographical review on the occurrence of the groups from the paddy water of the world. Aquatic Coleoptera collected along with the present material will be treated elsewhere.

The first author wishes to express his sincere gratitude to Dr. Y. Hirashima of Kyushu University, project leader, for his kind arrangement in joining the project. He is thankful to Dr. K. Aizawa, Dr. K. Morimoto, Dr. C. R. Baltazar, Mr. P. W. Resma and Mr. L. E. Padua for their help in collecting material and other ways. The kind help of Dr. K. Yasumatsu and Dr. C. H. Fernando for the literature and other ways is also greatly appreciated. Further, he is also grateful to entomologists and other officials who kindly cooperated to our field works in the Philippines.

### Materials and localities visited

Field surveys mentioned above have been done in Luzon and Mindanao of the Philippines in 1979. Many places were visited for the project, and collections on the aquatic insects of paddy water were made at the following four places on the dates enclosed in parentheses. Collections were made by an insect net (42cm in diameter and 30 cm in depth) which was reformed from ordinary sweep net by cutting its length.

**LUZON.** Banaue, Ifugao (July 27-31 and August 1)

Bay, Laguna (August 14)

**MINDANAO.** Tugbok, Davao City (August 28-30)

Bislig, Surigao del Sur (September 1-4)

General situations of these places are partly referred to Yasumatsu et al. (1975). The following additional notes on these places are mentioned here especially for the aquatic insect collections concerned.

**Banaue** (Fig. 1). This is the place famous for its rice terraces situated on rather steep slopes of mountains at an elevation of about 1300 meters or more above sea level. Narrow paddy fields are terraced by stone walls, and native variety of rice have been cultivated without applying insecticides and fertilizers. Paddy fields around Banaue were in the midst of harvest when the surveys were done. Almost all paddies regardless of

harvest hold water owing to the rainy season. Collections on aquatic insects were made at several paddies which were not harvested and had some vegetation of weeds.

**Bay.** The rice plants of paddy field where collections on aquatic insects were done were about 60 cm in height. Almost all paddy fields around there contain so much water. The paddy water investigated was partly running very slowly to the exit irrigation ditch owing to current heavy rains.

**Tugbok** (Fig. 2). Three paddy fields in a row were selected for collections. Irrigation water was flowing to these paddies for the next crop of rice, and no rice plant was planted then, and no weed was seen except for some floating debris. Nurseries were seen near the place. Rice plants of paddies around the place were in their tillering and flowering stages.

**Bislig** (Fig. 3). Paddy fields belonging to PICOP (Paper Industries Corporation of the Philippines) were visited for the project. Rice plants there were in the tillering stage to mature. The paddies where the collections of the aquatic insects were made were with rice plants of tillering stage and were almost drying up owing to poor rain-fall except for one tiny spot where paddy water still contained with many aquatic insects. Irrigation ditch by the paddy field mentioned above kept water, and collectings were made also at the ditch.

As mentioned above, these four places investigated are quite different from each other in terms of the condition of paddy water, growing stages of rice plants, and its surrounding environment. So, the notes in some respects in this paper such as distribution, abundance and others for the species collected is limited to a certain extent.

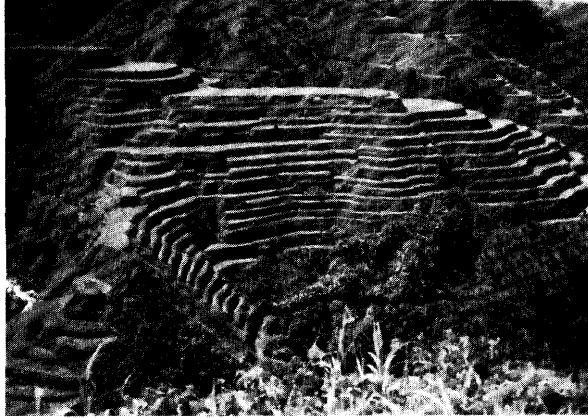
### Former record on the aquatic and semiaquatic Heteroptera from paddy water of the world

So far as we are aware, the following records on the aquatic and semiaquatic Heteroptera collected from paddy water were seen. These are summarized in Table 1. Some references quoted in the table (Reference B) mention the general knowledge on the paddy dwellings of respective species without giving any collecting data. Former records are reviewed chronologically in the following lines. Original scientific names are cited in parentheses when it is different from the present usage. Those not mentioned in the following lines are referred to the footnotes of Table 1.

1900-1949. Okada (1900) mentioned *Sigara substriata* attacking planthoppers in paddy fields in Shizuoka, Japan. He also observed a species attacking planthoppers and running on water surface of Japanese paddy fields. According to him this species belongs to Reduviidae, but his notes reveal species belonging to Veliidae and Hebridae also. His description almost fits to the character of Hebridae except for the ovipositor. Ito (1918) recorded that *Nepa rubra* (*N. cinema*) cut through the base of the young rice-plant in Argentina. Nawa (1924) mentioned that 4 aquatic Heteroptera, *Ochterus marginatus flavo-marginatus* (*Pelogonus flavomarginatus*), *Saldula recticollis* (*Salda recticollis*), *Paraplea indistinguenda* (*Plea indistinguenda*) and *Hydrometra albolineata* (*H. vittata*), are predaceous to planthoppers in Japanese paddy fields. He also indicated the occurrence of *Lethocerus deyrollei* and *Lac-*

*cotrephe japonensis* in paddy water. Sakai (1932, 1933) reported *Microvelia douglasi* feeding on leafhoppers in Japan. Moretti (1932) mentioned about 12 species belonging to 8 families of aquatic Heteroptera occurring in paddy field of Italy, and gave brief descriptions on their larvae and/or adults. Lundblad (1933) recorded 13 species belonging to 8 families of aquatic Heteroptera collected from paddy fields of Sumatra (12 species) and Java (1 species). Sawa (1935) studied the soil fauna of levee by paddy field in the winter (December to April) near Mito City, Japan, and found 25 individuals of Veliidae (specific name was not given but probably *Microvelia* species) from the soil mainly within 3 cm from the surface. Hutchinson (1940) reported 3 species of *Micronecta*, *quadristrigata*, *scutellariscutellaris* and *thyesa*, collected from Indian paddy fields. Esaki (1941) recorded three aquatic Heteroptera, *Ranatra unicolor*, *Diplonychus japonicus* and *Ilyocoris cimicoides* (*Naucoris cimicoides*) from the paddy field of N. China. Yago (1943) mentioned that *Lethocerus deyrollei* (*Kirkaldyia deyrollii*) is injurious to rice seedlings and young fishes in Japan. Rice seedlings are uprooted by the bug, he stated.

1950-1969. Brooks (1951) described *Anisops nodulata* from the Philippines which was collected from paddy fields of Pangasinan. Esaki and Miyamoto (1955) mentioned that *Microvelia douglasi* in Japan attacks *Recilia dorsalis* and probably *Nephotettix cincticeps* and *Sogatella furcifera* also. Oho and Fuzii (1956) found the rather high population density of *Microvelia douglasi* in less sprayed paddy fields of Saga Prefecture, Japan, when they made investigations on the influence of chemical control. Oho and Miyahara (1957) also reported that *Microvelia douglasi* is a predator of *Nephotettix cincticeps* in Kyushu, Japan. Weerakoon and Samarasinghe (1958) studied soil fauna of a paddy field in Sri Lanka and found one species each of the following genera: *Microvelia*, *Mesovelis*, *Ranatra*, *Diplonychus* and *Micronecta*. Fernando (1959) listed 13 species belonging to 7 families of aquatic Heteroptera taken in paddy fields in Sri Lanka, but no collecting data were given. Fernando (1961) noted that *Diplonychus rusticus* (*Sphaerodema rusticum*) was common in paddy fields of Sri Lanka. Kobayashi (1961) listed 8 aquatic Heteroptera predaceous to plant- and leafhoppers in Japanese paddy fields based on the previous knowledge. These are *Hebrus nipponicus*, *Hydrometra albolineata*, *Microvelia douglasi*, *M. horvathi*, *Saldula saltatoria*, *Saldula recticollis* (*Salda recticollis*), *Ochterus marginatus flavomarginatus* and *Paraplea indistinguenda*. In the paper he also reported the change of population density of *Microvelia douglasi* by the insecticide applications against rice stem borer. Ito et al. (1962) recorded *Gerris lacustris latibdominis* (*G. lacustris latibdominalis*), *Gerris (Aquarius) paludum insularis* (*Aquarius paludum*), *Microvelia douglasi* and *Hydrometra* sp. from paddy fields in Japan, and observed the first species attacks the rice stem borer larvae and the third one plant- and leafhoppers. Fernando (1963) mentioned that the following species were common in paddy fields near Nugegoda, Sri Lanka. They are *Microvelia longicornis*, *Micronecta quadristrigata*, *M. flavus*, *M. punctinotum*, *M. siva*, *M. fascioclavus* and *Anisops nivea*. Fernando and Leong (1963) recorded *Anisops kuroiwae* (*A. batillifrons*) from paddy fields in Sri Lanka. Lansbury (1964) recorded *Anisops breddini* collected from shallow large muddy pools on uncultivated rice fields of Viet Nam. Miyamoto (1964a) recorded two *Microvelia* species, *douglasi* and *morimotoi*, from paddy fields in the Nansei Is. Miyamoto (1964b) also recorded six aquatic species from paddy fields in the Nansei Is. They are *Saldoida armata*, *Mesovelis vittigera* (*M. orientalis*), *M. japonica*, *Limnogonus (L.) fossarum*, *Hydrometra annamana* and *H. yasumatsui*. Three females and one nymph of *Saldoida armata* among them were collected under stone in dried paddy field. Miyamoto (1965a) illustrated and mentioned that 15 species belonging to Saldidae (1 sp.), Hebridae (1 sp.), Hydrometridae (3 spp.), Veliidae (3 spp.), Gerridae (3 spp.), Belostomatidae (2 spp.), Notonectidae (1 sp.) and Corixidae (1 sp.) are found on or in paddy water in Japan. No collecting data, however, are presented for these species. Miyamoto (1965b) gave a note on the Japanese *Micronecta*, and mentioned that 3 species, *sedula*, *sahlbergi* and *orientalis*, dwell in paddy fields, but no data were given. Fernando (1965) mentioned that *Tropocorixa pruthiana* and *Micronecta quadristrigata* occur in paddy fields in



**Fig. 1.** Rice terraces of Banaue, Ifugao, Luzon. July 28, 1979.



**Fig. 2.** Paddy field of Tugbok, Davao City, Mindanao, where collectings of aquatic insects were made. August 30, 1979.



**Fig. 3.** Paddy field and irrigation ditch of Bislig, Surigao del Sur, Mindanao, where collectings of aquatic insects were made. September 4, 1979.

Table 1. Former records on the aquatic and semiaquatic Heteroptera from paddy water in the world<sup>1)</sup>.

Family	Species	Locality recorded from paddy water	Reference	
			(A) With data <sup>2)</sup>	(B) Without data
Saldidae	<i>Saldoida armata</i> Horváth	Japan	Miyamoto, 1964b	Miyamoto, 1965a; Hiura, 1977
	<i>Saldula ornatula</i> (Reuter)	Japan	Kobayashi et al., 1973	
		Philippines	Pawar, 1974	
	<i>Saldula recticollis</i> (Horváth)	Japan		Nawa, 1924 <sup>3)</sup> ; Kobayashi, 1961 <sup>4)</sup> ; Nasu, 1969 <sup>3)</sup>
	<i>Saldula saltatoria</i> (Linnaeus)	Japan		Kobayashi, 1961; Nasu, 1969
	Genus sp.	Japan	Miura, 1969	
Hebridae	<i>Hebrus nipponicus</i> Horváth	Japan		Kobayashi, 1961; Miyamoto, 1965a; Nasu, 1969; Hiura, 1977
	<i>Hebrus</i> sp.	Thailand	Heckman, 1979	
	<i>Hyrcaus capitatus</i> Distant	Thailand	Heckman, 1979	
Mesoveliidae	<i>Mesovelia japonica</i> Miyamoto	Japan	Miyamoto, 1964b	
	<i>Mesovelia vittigera</i> Horváth	Japan	Miyamoto, 1964b <sup>5)</sup>	
		Thailand	Heckman, 1979 <sup>5)</sup>	
		Sumatra	Lundblad, 1933 <sup>5)</sup>	
	<i>Mesovelia</i> sp.	Philippines	Kenmore, 1979	Chandra, 1978
	<i>Mesovelia</i> sp.	Sri Lanka	Weerekoon & Samarasinghe, 1958	
Veliidae	<i>Microvelia diluata</i> Distant	Philippines	Polhemus & Reisen, 1976	
	<i>Microvelia douglasi</i> Scott	Japan	Sakai, 1932, 1933; Esaki & Miyamoto, 1955; Oho & Fuzii, 1956; Oho & Miyahara, 1957; Kobayashi, 1961; Ito et al., 1962; Miyamoto, 1964a; Kobayashi et al., 1973	Miyamoto, 1965a; Nasu, 1969; Hiura, 1977
		Thailand		Yasumatsu et al., 1980
		Sumatra	Lundblad, 1933	
		Philippines	Kenmore, 1979 <sup>6)</sup> ; Polhemus & Reisen, 1973 <sup>6)</sup>	
	<i>M. d. atrolineata</i> Bergroth			

Gerridae	<i>Microvelia</i> sp. (nr <i>atrolineata</i> )	Philippines		Chandra, 1978
	<i>Microvelia horvathi</i> Lundblad	Japan	Kobayashi et al., 1973	Kobayashi, 1961; Miyamoto, 1965a; Nasu, 1969
	<i>Microvelia longicornis</i> Bue no	Sri Lanka		Fernando, 1963
	<i>Microvelia morimotoi</i> Miyamoto	Japan	Miyamoto, 1964a	
	<i>Microvelia pygmaea</i> Duf our	Italy		Moretti, 1932
	<i>Microvelia reticulata</i> Burmeister	Japan		Miyamoto, 1965a
	<i>Microvelia sinhalensis</i> Kirkaldy	Sri Lanka		Fernando, 1959
	<i>Microvelia</i> s p.	Laos	Heckman, 1974	
	<i>Microvelia</i> s p.	Sri Lanka	Weerekoon & Samarasinghe, 1958	
	Veliidae	Japan	Sawa, 1935	
	<i>Gerris adelaidis</i> Do hrm	Thailand		Yasumatsu et al., 1980
		Malaya		Cheng & Fernando, 1960
		Philippines	Polhemus & Reisen, 1976	
	<i>Gerris apterus</i> (Re tzius)	Italy		Moretti, 1932
	<i>Gerris lacustris</i> (Linnaeus)	Italy		More tti, 1932
	<i>G. 1. latiaabdominis</i> Miyamoto	Japan	Ito et al, 1962 <sup>7)</sup>	Miyamoto, 1965a; Hiura, 1977
	<i>Gerris paludum</i> (Fabricius)	Italy		Moretti, 1932
	<i>G. p. insularis</i> Motsch.	Japan	Ito et al., 1962 <sup>8)</sup>	
	<i>Limnogonus fossarum</i> (Fabricius)	Japan	Miyamoto, 1964b	Miyamoto, 1965a
		Malaya	Fernando & Cheng, 1974	Cheng & Fernando, 1969
		Philippines	Polhemus & Reisen, 1976	
		Sumatra	Lundblad, 1933	
	<i>Limnogonus hungerfordi</i> Andersen	Philippines	Polhemus & Reisen, 1976	
	<i>Limnogonus leptocerus</i> Reuter	Egypt	El-Sherif et al., 1976	
	<i>Limnogonus nitidus</i> (Mayr)	Sri Lanka		Fernando 1959 <sup>9)</sup>
		Malaya	Fernando & Cheng, 1974	Cheng & Fernando, 1969
		Sumatra	Lundblad, 1933	
	<i>Limnogonus parvulus</i> (Stål)	Japan		Miyamoto, 1965a
		Thailand	Heckman, 1979	Yasumatsu et al., 1980
		Malaya		Cheng & Fernando, 1969
	<i>Limnogonus severini</i> (Kirkaldy)	Kenya	Service, 1977	
	<i>Rhagadotarus kraepelini</i> Breddin	Philippines	Polhemus & Reisen, 1976	



	<i>Tenagobonus (Limnometra)</i> sp.	Philippines	Polhemus & Reisen, 1976	
	Genus sp. 1	Laos	Heckman, 1974	
	Genus sp. 2	Laos	Heckman, 1974	
Hydrometridae	<i>Hydrometra ? aegyptica</i> H. et E.	Kenya	Service, 1977	
	<i>Hydrometra albolineata</i> Scott	Japan	Kobayashi et al., 1973	Nawa, 1924 <sup>10</sup> ; Kobayashi, 1961; Miyamoto, 1965a; Nasu, 1969; Hiura, 1977 Miyamoto, 1965a
	<i>Hydrometra annamana</i> H. et E.	Japan	Miyamoto, 1964b	
	<i>Hydrometra lineata</i> Eschscholtz	Philippines	Pawar, 1974 <sup>11</sup> ; Polhemus & Reisen, 1976	
	<i>Hydrometra orientalis</i> Lundblad	Philippines Thailand	Polhemus & Reisen, 1976 Heckman, 1979	
	<i>Hydrometra procera</i> Horváth	Japan		Miyamoto, 1965a
	<i>Hydrometra stagnorum</i> (Linnaeus)	Italy		Moretti, 1932
	<i>Hydrometra yasumatsui</i> Miyamoto	Japan	Miyamoto, 1964b	
	<i>Hydrometra</i> sp.	Japan	Ito et al., 1962	
	<i>Hydrometra</i> sp.	Laos	Heckman, 1974	
Ochteridae	<i>Ochterus marginatus</i> (Latreille)	Philippines	Pawar, 1974	
	<i>O. m. flavomarginatus</i> Scott	Japan		Nawa, 1924 <sup>12</sup> ; Kobayashi, 1961; Nasu, 1969; Hiura, 1977 Fernando, 1959
Naucoridae	<i>Heleocoris bengalensis</i> Montandon	Sri Lanka		
	<i>Ilyocoris cimicoides</i> (Linnaeus)	China Italy	Esaki, 1941	Moretti, 1932 <sup>13</sup>
	<i>Naucoris obscuratus kenyalis</i> Poisson	Kenya	Service, 1977	
	Genus sp.	Laos	Heckman, 1974	
Pleidae	<i>Paraplea indistinguenda</i> (Matsumura)	Japan		Nawa, 1924 <sup>14</sup> ; Kobayashi, 1961; Nasu, 1969
	<i>Paraplea japonica</i> (Horváth)	Japan	Watanabe et al., 1968	
	<i>Paraplea liturata</i> (Fieber)	Sumatra Thailand	Lundblad, 1933 <sup>15</sup> Heckman, 1979 <sup>16</sup>	
	<i>Paraplea quinquemaculata</i> (Lundblad)	Thailand	Heckman, 1979 <sup>17</sup>	
	<i>Paraplea sobrina</i> (Stål)	Philippines	Polhemus & Reisen, 1976 <sup>18</sup>	
	<i>Plea atomaria</i> (Pallas)	Italy		Moretti, 1932 <sup>19</sup>

Notonectidae	<i>Anisops breddini</i> Kirkaldy	Laos	Heckman, 1974	
		Thailand	Heckman, 1979	
		Viet Nam	Lansbury, 1964	
	<i>Anisops crinita</i> Brooks	Sri Lanka		Fernando, 1959 <sup>20)</sup>
	<i>Anisops kuroiwaie</i> Matsumura	Japan		Miyamoto, 1965a
		Philippines	Pawar, 1974; Polhemus & Reisen, 1976 <sup>21)</sup>	
		Sri Lanka	Fernando & Leong, 1963 <sup>21)</sup>	Fernando, 1959 <sup>21)</sup>
		Thailand	Heckman, 1979 <sup>21)</sup>	
	<i>Anisops nivea</i> (Fabricius)	Sri Lanka		Fernando, 1963
		Sumatra	Lundblad, 1933	
	<i>Anisops nodulata</i> Brooks	Philippines	Brooks, 1951; Polhemus & Reisen, 1976	
	<i>Anisops ogasawarensis</i> Matsumura	Japan		Hiura, 1977 <sup>22)</sup>
	<i>Anisops philippinensis</i> Brooks	Philippines	Polhemus & Reisen, 1976	
	<i>Anisops sardea</i> Herrich-Schäffer	Egypt	El-Sherif et al., 1976	
	<i>Anisops</i> sp. (? <i>worthingtoni</i> Jaczewski)	Kenya	Service, 1973	
	<i>Anisops</i> sp. 1	Laos	Heckman, 1974	
	<i>Anisops</i> sp. 2	Laos	Heckman, 1974	
	<i>Enithares genitalis</i> Lundblad	Java	Lansbury, 1968	
	<i>Enithares mandalayensis</i> Distant	Thailand	Heckman, 1979	
	<i>Enithares sobria</i> Stål	Kenya	Service, 1973	
Nepidae	<i>Enithares uncatata</i> Lundblad	Sumatra	Lundblad, 1933	
	<i>Notonecta glauca</i> Linnaeus	Italy		Moretti, 1932
	<i>Notonecta triguttata</i> Motschulsky	Japan	Watanabe et al., 1968	
	Notonectidae	USA		Lange et al., 1970
	<i>Cercotmetus</i> sp.	Laos	Heckman, 1974	
	<i>Laccotrephes ater</i> (Linnaeus)	Kenya	Service, 1977	
	<i>Laccotrephes brachialis</i> Gerstäcker	Kenya	Service, 1977	
	<i>Laccotrephes fabricii</i> Stål	Kenya	Service, 1973	
	<i>Laccotrephes grossus</i> (Fabricius)	Laos	Heckman, 1974 <sup>23)</sup>	
		Sri Lanka		Fernando, 1959 <sup>23)</sup>
	<i>Laccotrephes japonensis</i> Scott	Japan	Watanabe et al., 1968	Nawa, 1924 ; Hiura, 1977

<i>Laccotrephes maculata</i> (Fabricius)	Sri Lanka		Fernando, 1959
<i>Laccotrephes robustus</i> Stål	Philippines	Polhemus & Reisen, 1976	
	Thailand	Heckman, 1979	
<i>Laccotrephes simulatus</i> Montandon	Sumatra	Lundblad, 1933	
<i>Laccotrephes</i> sp.	Kenya	Service, 1977	
<i>Nepa rubra</i> Linnaeus	Argentina	Ito, 1918 <sup>24)</sup>	
	Italy		Moretti, 1932 <sup>25)</sup>
<i>Ranatra bottegoi</i> Montandon	Kenya	Service, 1977	
<i>Ranatra chinensis</i> Mayr	Japan	Watanabe et al., 1968	
<i>Ranatra diminuta</i> Montandon	Philippines	Polhemus & Reisen, 1976	
<i>Ranatra elongata</i> Dohrn	Sri Lanka		Fernando, 1959
<i>Ranatra linearis</i> (Linnaeus)	Italy		Moretti, 1932
<i>Ranatra longipes</i> Stål	Malaya	Fernando & Cheng, 1974	
<i>Ranatra sordidula</i> Dohrn	Sri Lanka		Fernando, 1959
<i>Ranatra unicolor</i> Scott	China	Esaki, 1941	
<i>Ranatra varipes</i> Stål	Thailand	Heckman, 1979	
<i>Ranatra vicina</i> Signoret	Egypt	El-Sherif et al., 1976	
<i>Ranatra</i> sp.	Philippines	Polhemus & Reisen, 1976	
<i>Ranatra</i> sp.	Laos	Heckman, 1974	
<i>Ranatra</i> sp.	Sri Lanka	Weerekoon & Samarasinghe, 1958	
Belostomatidae <i>Diplonychus grassei</i> (Poisson)	Kenya	Service, 1977 <sup>26)</sup>	
<i>Diplonychus japonicus</i> (Vuillefroy)	Japan		Miyamoto, 1955a; Hiura, 1977
	China	Esaki, 1941	
<i>Diplonychus major</i> Esaki	Japan		Hiura, 1977
<i>Diplonychus molestus</i> (Dufour)	Malaya	Fernando & Cheng, 1974 <sup>27)</sup>	
<i>Diplonychus rusticus</i> (Fabricius)	Philippines	Pawar, 1974; Polhemus & Reisen, 1976	
	Sri Lanka		Fernando, 1959 <sup>28)</sup> , 1961 <sup>28)</sup>
	Sumatra	Lundblad, 1933 <sup>29)</sup>	
	Thailand	Heckman, 1979 <sup>29)</sup>	
<i>Diplonychus urinator</i> (Dufour)	Egypt	El-Sherif et al., 1976 <sup>30)</sup>	
<i>Diplonychus</i> sp.	Sri Lanka	Weerekoon & Samarasinghe, 1958 <sup>30)</sup>	
<i>Lethocerus deyrollei</i> (Vuillefroy)	Japan		Nawa, 1924; Yago, 1943 <sup>31)</sup> ;

Corixidae	<i>Lethocerus indicus</i> (Lep. et Serv.)	Thailand	Heckman, 1979	Miyamoto, 1965a; Hiura, 1977
		Sri Lanka		Fernando, 1959 <sup>32)</sup>
		Java	Lundblad, 1933	
	<i>Lethocerus niloticus</i> (Stål)	Egypt	El-Sherif et al., 1976	
	<i>Limnogeton fieberi</i> Mayr	Egypt	El-Sherif et al., 1976	
	Belostomatidae	USA		Lange et al., 1970
	<i>Agraptocorixa hyalinipennis</i> (F.)	Thailand	Heckman, 1979	
	<i>Agraptocorixa sweistraii</i> Hutchinson	Kenya	Service, 1973	
	<i>Hesperocorixa distantii</i> (Kirkaldy)	Japan		Hiura, 1977
	<i>Micronecta albifrons</i> (Motsch.)	Sri Lanka		Fernando, 1959
	<i>Micronecta fascioclavus</i> Chen	Sri Lanka		Fernando, 1963
	<i>Micronecta flavens</i> Wroblewski	Sri Lanka		Fernando, 1963
	<i>Micronecta haliploides</i> Horváth	Sumatra	Lundblad, 1933	
	<i>Micronecta minutissima</i> (Linnaeus)	Italy		Moretti, 1932 <sup>33)</sup>
	<i>Micronecta orientalis</i> Wroblewski	Japan		Miyamoto, 1965b
	<i>Micronecta plicata</i> (Costa)	Egypt	El-Sherif et al., 1976	
	<i>Micronecta punctata</i> Fieber	Malaya		Fernando & Cheng, 1974
	<i>Micronecta punctinotum</i> Chen	Sri Lanka		Fernando, 1963
	<i>Micronecta quadristrigata</i> Breddin	India	Hutchinson, 1940 <sup>34)</sup>	
		Malaya		Fernando & Cheng, 1974
		Philippines	Pawar, 1974; Polhemus & Reisen, 1976	
		Sri Lanka		Fernando, 1959 <sup>35)</sup> , 1963, 1965
		Sumatra	Lundblad, 1933	
	<i>Micronecta sahlbergi</i> Jakovlev	Japan		Miyamoto, 1965b
	<i>Micronecta scutellaris</i> (Stål)	Kenya	Service, 1977	
	<i>M. (Basileonecta) s. scutellaris</i> (Stål)	India	Hutchinson, 1940	
	<i>Micronecta sedula</i> Horváth	Japan		Miyamoto, 1965a, b; Hiura, 1977
	<i>Micronecta siva</i> (Kirkaldy)	Sri Lanka		Fernando, 1963
	<i>Micronecta (Indonecta) thyesta</i>	Distant India	Hutchinson, 1940	
	<i>Micronecta</i> sp.	Laos	Heckman, 1974	
	<i>Micronecta</i> sp.	Sri Lanka	Weerekoon & Samarasinghe, 1958	

<b><i>Sigara connena</i></b> Lundblad	Sumatra	Lundblad, 1933	
<b><i>Sigara hedenborgi</i></b> Lundblad	Kenya	Service, 1977	
<b><i>Sigara lateralis</i></b> (Leach)	Egypt	El-Sherif et al., 1976	
<b><i>Sigara pectoralis</i></b> Fieber	Kenya	Service, 1977	
<b><i>Sigara striata</i></b> Linnaeus	Italy		Moretti, 1932 <sup>36)</sup>
<b><i>Sigara substriata</i></b> (Uhler)	Japan	Watanabe et al., 1968	Okada, 1900
<b><i>Sigara sp.</i></b>	Kenya	Service, 1973	
<i>Tropocorixa pruthiana</i> Hutchinson	Sri Lanka		Fernando, 1965
Genus sp.	Laos	Heckman, 1974	
Corixidae	USA		Lange et al., 1970
Family ?	Japan	Okada, 1900	

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1. References marked by a superior number used scientific names different from the present usage, and the original ones are cited in the footnote.

Nasu (1969) listed natural enemies of rice leafhoppers according to Kobayashi (1961), Hinckley (1963) and O'Connor (1952). Aquatic Heteroptera among them are probably cited from Kobayashi (1961) and not from others judging from the contents of the latter two articles. So, the species of Nasu (1969) in this table are listed under Japan.

2. References with collecting or observing data including primarily locality name, date and collector or observer name. Some literature gave no exact dates but rather restricted locality names were given.

3. <b><i>Salda recticollis</i></b> Horvath	<b><i>Salda recticollis</i></b> Horvath
5. <b><i>Mesovelis orientalis</i></b> Kirkaldy	<b><i>Microvelis atrolineata</i></b> Bergroth
7. <b><i>Gerris lacustris latibdominalis</i></b>	<b><i>Aquarius paludum</i></b>
9. <b><i>Gerris nitida</i></b> (Mayr)	10. <b><i>Hydrometra vittata</i></b> Stål
11. <b><i>Hydrometra lineatus</i></b> Eschscholtz	12. <b><i>Pelogonus flavomarginatus</i></b> Scott
13. <b><i>Naucoris cimicoides</i></b> (Linnaeus)	14. <b><i>Plea indistinguenda</i></b> Matsumura
15. <b><i>Plea (Paraplea) liturata</i></b> (Fieber)	16. <b><i>Plea liturata</i></b> Fieber
17. <b><i>Plea quinquemaculata</i></b> Lundblad	18. <b><i>Plea sobrina</i></b> Stål
19. <b><i>Plea minutissima</i></b> Fabricius	20. Fernando and Cheng (1963) mentioned this species is <b><i>A. exigera</i></b> Horvath.
21. <b><i>Anisops batillifrons</i></b> Lundblad	22. <b><i>Anisops genji</i></b> Hutchinson
23. <b><i>Laccotrephes ruber</i></b> Linnaeus	24. <b><i>Nepa cinerea</i></b> (Linnaeus). Cited indirectly. It has not ascertained about exact data.
25. <b><i>Nepa cinerea</i></b> (Linnaeus)	26. <b><i>Sphaerodema grassei</i></b> Poisson
27. <b><i>Sphaerodema molestum</i></b> (Dufour)	28. <b><i>Sphaerodema rusticum</i></b> (Fabricius)
29. <b><i>Sphaerodema urinator</i></b> Dufour	30. <b><i>Sphaerodema</i></b> sp.
31. <b><i>Kirkaldyia deyrolli</i></b> Vuill.	32. <b><i>Belostoma indica</i></b> Lep. et Serv.
33. <b><i>Sigara minutissima</i></b> Leach	34. <b><i>Micronecta (Basileonecta) quadristrigata</i></b> Breddin
35. <b><i>Micronecta quadrisignata</i></b> Breddin	36. <b><i>Corisa striata</i></b> Linnaeus

Sri Lanka. Watanabe et al. (1968) surveyed on the natural enemies of *Culex tritaeniorhynchus summosus* of paddy field in Okayama, Japan. They collected adults and nymphs of the following 5 species of 4 families: *Ranatra chinensis*, *Laccotrephes japonensis*, *Notonecta triguttata*, *Paraplea japonica* and *Sigara substriata*. These authors checked the feeding of these species by giving larvae of *Culex tritaeniorhynchus summosus* and found *Notonecta triguttata*, *Ranatra chinensis* and *Laccotrephes japonensis* are active in feeding the larvae, and *Paraplea japonica* and *Sigara substriata* are not active. Lansbury (1968) recorded 6 specimens of *Enithares genitalis* collected from paddy fields near Bogor, Java. Cheng and Fernando (1969) noted the occurrence of 4 Gerrid species from Malayan paddy fields. These are *Limnogonus fossarum*, *L. parvulus*, *L. nitidus* and *Gerris adelaidis*. Miura (1969) collected 3 specimens of a species of Saldidae by sweeping nurseries in Matsue, Japan. Nasu (1969) cited 8 species of aquatic Heteroptera predaceous to rice leafhoppers based on the record of Kobayashi (1961).

1970-1980. Lange et al (1970) mentioned the occurrence of Belostomatidae, Notonectidae and Corixidae in paddy fields of California. They stated that the Corixidae cause some damage to rice seedlings. Service (1973, 1977) made researches on the mortalities of the larvae of *Anopheles gambiae* complex in Kenya, and used 17 species including 3 unidentified species of aquatic Heteroptera dwelling in paddy fields for it. These species are *Hydrometra* ? *aegyptica*, *Limnogonus severini*, *Micronecta scutellaris*, *Sigara hedenborgi*, *S. pectoralis*, *Sigara* spp., *Agraptocorixa sweistræi*, *Laccotrephes brachialis*, *L. ater*, *L. fabricii*, *L. sp.*, *Ranatra bottegoi*, *Diplonychus grassei* (*Sphaerodema grassei*), *Anisops* sp. (? *worthingtoni*), *Enithares sobira* and *Naucoris obscuratus kenyalis*. Kobayashi et al. (1973) collected the paddy dwelling insects in Tokushima, Japan, and listed the following 4 aquatic Heteroptera: *Hydrometra albolineata*, *Microvelia douglasi*, *M. horvathi* and *Saldula ornatula*. Pawar (1974, mimeographed) presented a terminal paper to IRRI on the insects of rice in the Philippines. He listed 6 species of aquatic Heteroptera collected from paddy fields. They are *Micronecta quadristrigata*, *Saldula ornatula*, *Hydrometra lineata* (*H. Zineatus*), *Ochterus marginatus*, *Diplonychus rusticus* (*D. rusticum*) and *Anisops kuroiwae* (*A. kuroiwa*). Pawar listed one more species, *Lethocerus indicus*, which was collected by light trap in paddy field. Heckman (1974) studied on the seasonal succession of species in a paddy field in Laos. He observed 14 aquatic Heteroptera including 12 unidentified species. Fernando and Cheng (1974) stated in their paper on the aquatic Hemiptera in Malaya and Singapore that 6 species of 4 families were found in Malayan paddy fields. They are *Limnogonus fossarum*, *L. nitidus*, *Ranatra longipes*, *Diplonychus molestus* (*Sphaerodema molestum*), *Micronecta quadristrigata* and *M. punctata*. Locality names in Malaya were given for the first 4 species and no data were presented for the last 2 species. El-Sherif et al. (1976) made surveys on aquatic insects of rice nurseries and paddy fields in Egypt, and collected the following species of Heteroptera. They are *Limnogonus leptocerus*, *Micronecta plicata*, *Sigara lateralis*, *Ranatra vicina*, *Lethocerus niloticus*, *Limnogeton fieberi*, *Diplonychus urinator* (*Sphaerodema urinator*) and *Anisops sardea*. According to them, *Micronecta plicata*, *Diplonychus urinator* (*S. urinator*) and *Anisops sardea* are rather common among these species concerned. Polhemus and Reisen (1976) reported the aquatic Hemiptera of the Philippines mainly based on the material collected from the Luzon and some from other islands. Among the species reported, 17 species and 1 unidentified species belonging to 8 families were collected from paddy fields including adjoining irrigation ditches. Hiura (1977) stated in a colored illustration book that 13 species of aquatic Heteroptera are seen in paddy fields of Japan, but no collecting data are available. These 13 species are same to those of Miyamoto (1965a) except for 5 species, *Hesperocorixadistanti*, *Ochterus marginatus flavomarginatus*, *Laccotrephes japonensis*, *Diplonychus major* and *Anisops ogusawarensis* (*A. genji*). In 1978. Chandra reported that *Microvelia* sp. nr *atrolineata* and *Mesovelvia* sp. attack the rice leaf- and planthoppers in the Philippines. Kenmore (1979, mimeographed) mentioned that *Microvelia douglasi atrolineata* (*M. atrolineata*) is a predator of the brown planthopper, white backed planthopper, and rice green leafhopper, and *Mesovelvia*

**Table 2.** Known prey records of aquatic and semiaquatic Heteroptera from paddy water of the world\*.

Family	Predaceous species	Prey insect recorded	Locality recorded	Reference
Saldidae	<i>Saldula reticulata</i> (Horváth)	planthoppers	Japan	Nawa, 1924
	<i>Saldula saltatoria</i> (Linnaeus)	plant- and leafhoppers	Japan	Kobayashi, 1961
Hebridae	<i>Hebrus nipponicus</i> Horváth	plant- and leafhoppers	Japan	Kobayashi, 1961
Mesoveliidae	<i>Mesovelia</i> sp.	plant- and leafhoppers	Philippines	Chandra, 1978
		<i>Nilaparvata lugens</i> (Stål)	Philippines	Kenmore, 1979
Veliidae	<i>Microvelia douglasi</i> Scott	leafhoppers	<b>Japan</b>	Sakai, 1932, 1933; Kobayashi, 1961; Ito et al., 1962
		planthoppers	<b>Japan</b>	Kobayashi, 1961; Ito et al., 1962
		plant- and leafhoppers	Thailand	Yasumatsu et al., 1980
		<i>Recilia dorsalis</i> Motschulsky	<b>Japan</b>	Esaki & Miyamoto, 1955
		<i>Nephotettix cincticeps</i> Uhler	<b>Japan</b>	Oho & Miyahara, 1957
		<i>Nilaparvata lugens</i> (Stål)	Philippines	Kenmore, 1979
		<i>Sogatella furcifera</i> Horváth	Philippines	Kenmore, 1979
		<i>Nephotettix cincticeps</i> Uhler	Philippines	Kenmore, 1979
		<i>Microvelia</i> sp. (nr <i>atrolineata</i> )	Philippines	Chandra, 1978
		<i>Gerris adelaidis</i> Dohrn	Thailand	Yasumatsu et al., <b>1980</b>
Gerridae	<i>Gerris lacustris latibdominis</i> Miyamoto	<i>Chilo suppressalis</i> Walker	Japan	Ito et al., 1962
	<i>Limnogonus parvulus</i> (Stål)	plant- and leafhoppers	Thailand	Yasumatsu et al., <b>1980</b>
Hydrometridae	<i>Hydrometra albolineata</i> Scott	planthoppers	<b>Japan</b>	Nawa, 1924
		plant- and leafhoppers	<b>Japan</b>	Kobayashi, 1961
Ochteridae	<i>Ochterus marginatus flavomarginatus</i> Scott	planthoppers	<b>Japan</b>	Nawa, 1924; Kobayashi, 1961
		leafhoppers	<b>Japan</b>	Kobayashi, 1961
Pleidae	<i>Paraplea indistinguenda</i> (Matsumura)	planthoppers	Japan	Nawa, 1924; Kobayashi, 1961
		leafhoppers	<b>Japan</b>	Kobayashi, 1961
Corixidae	<i>Sigara substriata</i> (Uhler)	planthoppers	<b>Japan</b>	Okada, 1900
	<i>Micronecta quadristrigata</i> Breddin	midge larva	Philippines	Pawar, 1974
Family ?	Genus sp.	planthoppers	<b>Japan</b>	Okada, 1900

\* Scientific names of this table are present usage and the original ones are referable to the footnotes of Table 1.

sp. is also predaceous to the brown planthopper in the Philippines. Heckman (1979) reported the occurrence of 15 aquatic Heteroptera in northern Thailand. These species belong to Hebridae (2 spp.), Mesoveliidae (1 sp.), Hydrometridae (1 sp.), Gerridae (1 sp.), Corixidae (1 sp.), Nepidae (2 spp.), Belostomatidae (2 spp.), Notonectidae (3 spp.), and Pleidae (2 spp.). Yasumatsu et al. (1980, mimeographed) listed *Microvelia douglasi*, ***Gerris adelaidis*** and *Limnogonus parvulus* as nymphal or adult predators of plant- and leafhoppers in Thailand.

One hundred and fourteen species and five subspecies belonging to 13 families including species without no definite data and excluding unidentified ones have been recorded from paddy water in the world. Dominant families may be Corixidae, Nepidae, Notonectidae, Belostomatidae, Gerridae, Veliidae and Hydrometridae among the families concerned. Most species were recorded without any biological informations such as food habits, seasonal abundance, and so on. About ten species have been reported with their food habit as shown in Table 2. It is apparent that very limited species are reported with their exact host species compared with the known species. Host insects recorded are mostly plant- and leafhoppers except for two cases of rice stem borer and midge larva. Only 6 species of host have been recorded by their specific names for 4 predaceous species. Host insects reported under the name of plant- and/or leafhoppers without giving specific name are required to be checked for its exact host name. Other insect and animal groups which have not recorded before are also attacked by aquatic Heteroptera in paddy ecosystem (Yano, unpublished data), but it has not been reported so far as we are aware. Apart from paddy water, however, these aquatic Heteroptera have been reported to attack various organisms. Further studies on their food habits may probably make their status in biological control in paddy field ecosystem more clear. It may also reveal the habit attacking other predaceous species as seen in other environment (Riley, 1922).

Two species, *Nepa rubra* and *Lethocerus deyrollei*, have been reported to be injurious to rice plant as cited above. Some damage by the Corixidae have been reported also (Lange et al., 1970) but it is not serious. Only three families, Nepidae, Belostomatidae and Corixidae among the all families recorded from paddy fields include some species injurious to rice seedlings. It is consequently noted here that the aquatic Heteroptera in paddy fields are negligible as pest insects of rice. It is obvious that the expected figure of paddy dwelling species in each country is bigger than that of the known data. These figures, known or expected, are too big to neglect their presence in the paddy field ecosystem. Faunal and biological studies on the group are thus expected.



### Species collected in the Philippines with descriptions of new species

A total of 717 specimens of 17 species belonging to 11 families were collected and enumerated in the following lines. All specimens were collected by the first author, and from paddy water unless otherwise stated. Among the material collected by sweep net made above water level in Pila, Laguna, 2 specimens of the family Ochteridae were found and included here. Eight specimens of *Saldoida armata* Horvath collected by Dr. K. Morimoto from levee by paddy field of Banaue were included here also through his courtesy. The material collected from irrigation ditch water by paddy field in Bislig, Mindanao, are also included here with indication of irrigation ditch. Locality based on the paddy water material is shown with an asterisk. All measurements in the descriptions of new species are in mm.

#### SALDIDAE

##### *Saldoida armata* Horvath

SPECIMENS EXAMINED: 4 adults, 4 nymphs, Banaue, Ifugao, 27-31. vii. 1979, K. Morimoto, levee by paddy field.

DISTRIBUTION: Philippines\*, Japan, Nansei Is., Taiwan, India.

These specimens were collected at levee by paddy field which contained water.

#### HEBRIDAE

##### *Hebrus bergrothi* Horvath (Fig. 11)

SPECIMEN EXAMINED: 1 adult, Banaue, Ifugao, 1. viii. 1979.

DISTRIBUTION: Philippines\* (endemic).

This is the first record from paddy water of the world and the first record of the family Hebridae from the Philippine paddy water.

#### MESOVELIIDAE

##### *Mesovelvia vittigera* Horvath (Fig. 12)

SPECIMENS EXAMINED: 24 adults, 13 nymphs, Tugbok, Davao City, 28-30. viii. 1979. 2 adults, Bislig, Surigao del Sur, 1-4. ix. 1979.

DISTRIBUTION: Philippines\*, Taiwan, Japan\*, Nansei Is., Sumatra\*, Thailand\*, Korea, India, S. E. Asia, New Guinea, Guam, Middle East, S. Europe, Africa.

This is the species formerly known as *M. orientalis* Kirkaldy in Japan and its adjacent territories. It is not certain that an unidentified species of *Mesovelvia* recorded by Chandra (1978) and Kenmore (1979) from the Philippines are identical with this species or not. This species seems to be common in the Philippine paddy water.

#### VELIIDAE

##### *Microvelia douglasi atrolineata* Bergroth, stat. nov. (Figs. 5, 6, 13)

SPECIMENS EXAMINED: 140 adults, 60 nymphs, Bay, Laguna, 14. viii. 1979. 1 adult, 15 nymphs, Tugbok, Davao City, 28-30. viii. 1979. 3 adults, 8 nymphs, Bislig, Surigao del Sur, 1-4. ix. 1979.

DISTRIBUTION: Philippines\*.

Polhemus and Reisen (1976) separated *atrolineata* from *douglasi* by the coloration and a lateral compression of the female abdomen. But *douglasi* (Fig. 4) is grayish as well as



Fig. 4. *Microvelia douglasi*, ♂, Fukuoka, Japan.

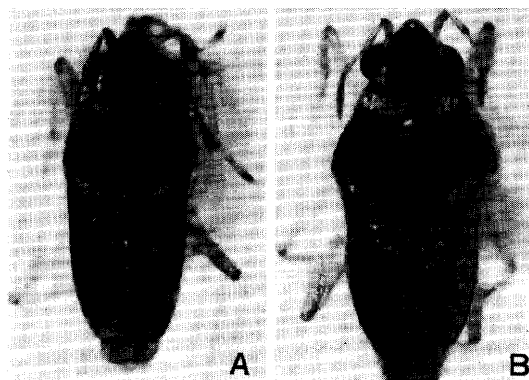
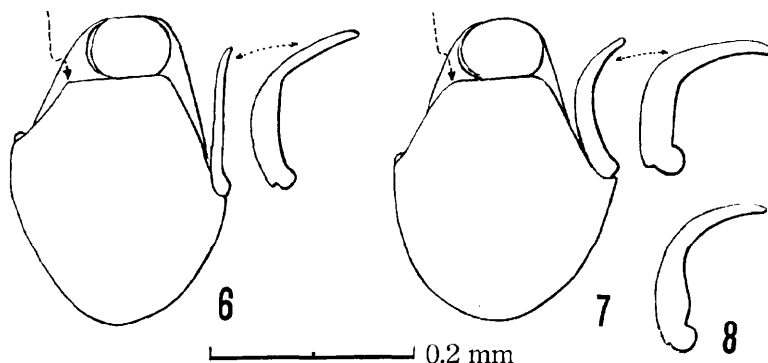


Fig. 5. *Microvelia douglasi atrolineata*. A: ♂, Bay, Laguna. B: ♀, same data.

brown in coloration, and the former colour is dominant, and some specimens of *atrolineata* are quite brown-coloured. Lateral compression at the base of female abdomen may be a good character for *atrolineata*, but sometimes Japanese *douglasi* also shows the same tendency. Male genital segments and parameres of the two forms are seen in the Figures 6-8. According to the Lundblad's system of *douglasi* (1933: 347-357), these differences may be within a range of species. General shape of *atrolineata* is rather shorter and broader than in *douglasi*.



Figs. 6-8. *Microvelia douglasi atrolineata*, from Laguna, Philippines (6) and *M. douglasi*, from Fukuoka, Japan (7 and 8). 6, 7: Apical segments of abdomens, in ventral view, of respective forms, accompanying with right-hand parameres. 8: Right-hand parameres of another specimen of *douglasi*.

Many specimens including immature stages were collected at Bay. It is obvious that this is one of the most common species with numerous individuals among the paddy dwelling aquatic Heteroptera in the Philippines. It may be due to the different condition of paddy water that less specimens were collected at Tugbok and Bislig. The water at Tugbok was then flowing into the paddy fields where collectings were made and time had not been passed from the water was let in. The paddy water at Bislig was not enough but extremely limited into tiny spot. It is unknown, however, why no specimens were collected from Banaue. *M. diluta* Distant was recorded by Polhemus and Reisen (1976) from Lubang Island, but no specimens were collected by the present survey.

## GERRIDAE

**Limnogonus fossarum** (Fabricius) (Fig. 14)

SPECIMENS EXAMINED: 1 adult, Banaue, Ifugao, 1. viii. 1979. 1 adult, Tugbok, Davao City, 28-30. viii. 1979. 2 adults, Bislig, Surigao del Sur, 1-4. ix. 1979, irrigation ditch.

DISTRIBUTION: Japan, Nansei Is\*, Taiwan, China, Philippines\*, Malaya\*, Singapore, Celebes, Java, Sumatra\*, Sri Lanka, India, Micronesia, Fiji.

This species is distributed up to the Nansei Islands, Japan. Five specimens were collected previously from paddy water of Ishigaki I., Nansei Is. Cheng and Fernando (1969) mentioned that this is the commonest and most widespread among Malayan Gerridae. They examined 2 specimens from Malayan paddy fields, and many from other aquatic habitats.

**Limnogonus nitidus** (Mayr) (Fig. 15)

SPECIMENS EXAMINED: 15 adults, 4 nymphs, Tugbok, Davao City, 28-30. viii. 1979. 3 nymphs, Bislig, Surigao del Sur, 1-4. ix. 1979. 16 adults, ditto, 1-4. ix. 1979, irrigation ditch.

DISTRIBUTION: Philippines\*, Malaya\*, Singapore, Sri Lanka\*, India, Burma, Java, Sumatra\*.

Cheng and Fernando (1969) noted this species is the least common of *Limnogonus* species in Malaya, occurring only in paddy fields and temporary pools. Judging from the present collection, this species may be distributed throughout the Philippine paddy fields of the plain area

**Limnogonus parvulus** (Stål) (Fig. 16)

SPECIMENS EXAMINED: 4 adults, Banaue, Ifugao, 27-31. vii. 1979. 16 adults, ditto, 1. viii. 1979.

DISTRIBUTION: Philippines\*, Japan\*, Nansei Is., Thailand\*, Malaya, Singapore, Sri Lanka, China, India, Java, Arabia.

This species was not collected from plain areas of Luzon and Mindanao where the following species was collected. So far as the present knowledge is concerned, however, this species seems to be distributed most widely in S. E. Asian paddy water among the known species of this family.

## HYDROMETRIDAE

**Hydrometra lineata** Eschscholtz (Fig. 17)

SPECIMENS EXAMINED: 1 adult, Banaue, Ifugao, 1. viii. 1979. 19 adults, Tugbok, Davao City, 28-30. viii. 1979. 1 adult, Bislig, Surigao del Sur, 1-1. ix. 1979. 2 adults, ditto, 1-4. ix. 1979, irrigation ditch.

DISTRIBUTION: Philippines\*, Java, Sumatra, Malaya, Sri Lanka.

Most specimens of the present material were collected from Tugbok. These individuals were found associating with debris on water surface or near levee.

**Hydrometra orientalis** Lundblad (Fig. 18)

SPECIMENS EXAMINED: 7 adults, Tugbok, Davao City, 28-30. viii. 1979. 5 adults, Bislig, Surigao del Sur, 1-4. ix. 1979, irrigation ditch.

DISTRIBUTION: Philippines\*, Sumatra, Java, Malaya, Burma, Thailand, Viet Nam.

## OCHTERIDAE

**Ochterus marginatus** (Latreille) (Fig. 19)

SPECIMENS EXAMINED: 2 adults, Pila, Laguna, 18 & 21. viii. 1979, sweeping paddy field.

DISTRIBUTION: Philippines\*, Taiwan, China, India, Middle East, S. Europe, N. Africa.

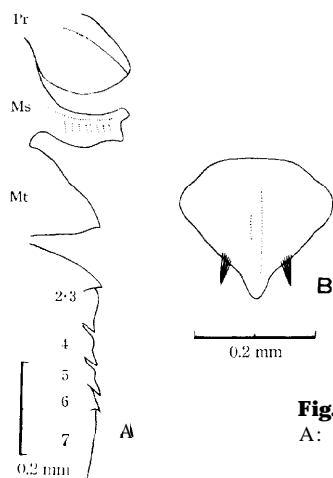
These two specimens were collected by sweeping made above water level. Japanese subspecies, *O. marginatus flavomarginatus*, is rather common around boundary between paddy water and levee.

## PLEIDAE

***Paraplea davaoensis* Miyamoto, sp. nov.** (Figs. 9, 20, 21)

Size, female. Body length 1.70 mm., greatest width across abdomen 0.93 mm.

General colour brownish ; head stramineous, somewhat brown centrally, without markings, with eyes reddish brown and rostrum dark brown; pronotum brownish, with anterior and lateral margins broadly, distinctly pale and posterior margin obscurely pale : the disc with one pair of dark brown spots and an additional one near anterior margin, one black spot near each humeral angle, and with a median black spot near posterior margin ; scutellum brown, with postero-lateral margins stramineous ; hemelytra brown with pale markings, each at base and center of corium and at center of clavus. Legs stramineous. -Body beneath dark brown.



**Fig. 9.** *Paraplea davaoensis*, sp. nov. ♀.  
A: Median sternal keels, lateral view.  
B: Subgenital plate.

Body shape ellipsoid; dorsal surface covered with distinct punctures, those on head and scutellum smaller than on the rest. Head, seen from above, short, about one sixth as long as wide (.13:.80), with the apical margin evenly rounded; in frontal view, head wider than tall (.34:.80). Rostrum reaching apices of anterior coxae, with the apical segment slightly longer than the preceding (.12:.10). Pronotum, in median length, a little longer than half the width between humeri (.53:.93), with humeral angles rather prominent; lateral margins divergent; posterior margin convex, with median portion somewhat emarginate; scutellum shorter than wide (.35:.50). Abdomen almost equal to length from head to scutellum, and widest at level of tip of scutellum.

Relative lengths of leg segments:

	Femur	Tibia	Tarsus (tarsal segments combined together)
Anterior leg	.50	.35	.20
Middle leg	.45	.32	.18
Posterior leg	.43	.45	.42

Median sternal keels of thorax and abdomen characteristic, and figured [Fig. 9-A] ; prosternal keel largest with ventral apex rounded; mesosternal keel nearly of equal width from near base to apex, with antero-ventral angle projected; metasternal keel triangular. Subgenital plate (operculum or seventh abdominal sternum) (Fig. 9-B) somewhat triangular, as wide as long (.25:.23), broadest before middle, with postero-lateral margins wavyly sinuate and furnished with a tuft of hairs on each side near apex.

Holotype female (Type No. 2236, Kyushu Univ.), Tugbok, Davao City, 28-30. viii. 1979, paddy water, K. Yano leg. The type is preserved in the Entomological Laboratory, Kyushu University.

The present species is easily separated from *P. sobrina* Stål, an only known species from the Philippines, in the smaller size, black spots on pronotum and peculiar structure of the sternal keels of thorax and abdomen, but *davaoensis* may be closely related to *P. liturata* (Fieber), which is variable in size and colour pattern, but distinguished from the latter by the different structure of sternal keels of thorax and abdomen (compared with the Lundblad's drawings, 1933, fig. 42 on p. 133).

This is the first record of this family from the Philippine paddy water.

#### NOTONECTIDAE

##### *Anisops kuroiwa* Matsumura (Fig. 22)

SPECIMENS EXAMINED: 1 adult, 1 nymph, Bay, Laguna, 14. viii. 1979. 9 adults, 26 nymphs, Bislig, Surigao del Sur, 1-4. ix. 1979. 3 adults, ditto, 1-4. ix. 1979, irrigation ditch.

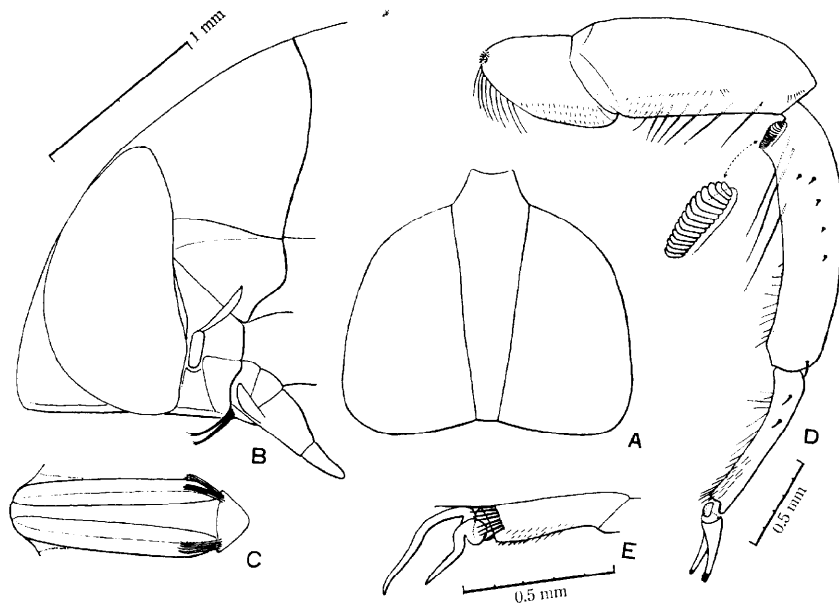
DISTRIBUTION: Japan\*, Nansei Is., Philippines\*, Thailand\*, Hainan Is., China, Taiwan, Burma, Assam, India.

This species was known as *A. batillifrons* Lundblad and seems to be distributed rather widely over Southeast Asian paddy water. It is a preliminary view that the species of this family will not be dominant at the starting period of paddy water ecosystem. Other groups on water surface dwellers such as Veliidae and Gerridae will be dominant from that time.

##### *Anisops nodulata* Brooks (Fig. 23)

SPECIMENS EXAMINED: 1 adult, Banaue, Ifugao, 27-31. vii. 1979. 3 nymphs, ditto, 1. viii. 1979.

DISTRIBUTION: Philippines\* (endemic).



**Fig. 10.** *Anisops yanoi*, sp. nov. ♂. A: Head, oblique dorsal view to the body axis. B: Head with prothorax, lateral view. C: Frons, full view. D: Left-hand anterior leg, E: Apical segment with claws of left-hand middle leg.

***Anisops yanoi* Miyamoto, sp. nov.** (Figs. 10, 24)

Size. Males, length 7.3-7.5 mm., greatest width 1.9-2.0 mm ; females, length 6.8-7.2 mm., greatest width 2.0 mm.

General colour somewhat stramineous. Eyes brown, anterior margin of vertex in male darkened, and antennae dark brown. Hemelytra hyaline and appearing stramineous towards base and gray near apex depending on the underlying body surface. Legs stramineous ; all coxae widely dark brown ; anterior femora with trochanters and middle femora broadly dark brown on dorsal surface, anterior tibiae each with a dark brown, distinct stria on dorsal side. Venter blackish brown with median keel and segmental margins of connexivum stramineous.

**Male:** Viewed from above, lateral outline of head rounded with vertex extending beyond anterior margins of eyes to form a short cephalic horn (Fig. 10) ; head about nine tenths as broad as pronotal humeral width (1.65 : 1.90) and almost four times the anterior width of vertex (1.65 : .44) ; synthlipsis narrow, nearly one fourth the anterior width of vertex; head slightly less than pronotum in median length (.90 : 1.00). Pronotum approximately twice as wide as long (1.90 : 1.00) ; lateral margins diverging and more than half the median length ; posterior margin convex, medially emarginate. Frons medially sulcate throughout (Fig. 10-C) ; apex rounded viewed from above or below, but emarginate as seen obliquely to body axis; each side bordered by two carinae, the inner ones not meeting with each other. Labrum short, about twice as broad as long at base, apex rounded, and furnished with a tuft of long erect hairs near each basal corner (Figs. 10-B, C). Rostral prong (Fig. 10-B) shorter than the third rostral segment, with apex acute.

Stridulatory comb (Fig. 10-D) of about fifteen teeth, the second to sixth teeth somewhat larger than others. Middle tarsal claws (Fig. 10-E) strongly curved inwards at base, posterior claw much thicker but shorter than anterior one. Chaetotaxy of anterior leg as shown in Fig. 10-E, without large spines.

## Relative lengths of leg segments:

	Femur	Tibia	Tars. seg. 1	Tars. seg. 2
Anterior leg	1.28 (or 100	1.40 :	.80 109	66 -)
Middle leg	2.48 (or 100	2.04 :	1.12 82	.40 45 : 16)
Posterior leg	2.80 (or 100	2.20 :	.80 70	.80 29 : 29)

**Female:** Viewed from above, outline of head rounded, nine tenths as broad as pronotal humeral width (1.65 : **1.90**) and about four times the anterior width of vertex (1.64 : .40) ; synthlipsis less than one half the anterior width of vertex (.18 : .40) ; head, along the median axis, about two thirds the pronotal length (.56 : .81). Humeral width of pronotum slightly more than twice its median length (1.90 : .81) ; lateral margins divergent and slightly more than one half the median length: posterior margin convex, medially emarginate.

## Relative lengths of leg segments:

	Femur	Tibia	Tars. seg. 1	Tars. seg. 2
Anterior leg	1.12 (or 100	1.32 :	.62 118	.40 54 : 36)
Middle leg	2.00 (or 100	1.68 :	.86 84	.48 43 : 24)
Posterior leg	2.65 (or 100	2.32 :	.80 88	.78 30 : 29)

Holotype male (Type No. 2237, Kyushu Univ.), and 6 paratypes (1 male and 5 females), Banaue, Ifugao, 27-31. vii and 1. viii. 1979, all from paddy water, K. Yano leg. The holotype is preserved in the Entomological Laboratory, Kyushu University.

The combination of characters such as the grooved frons, a pair of tufts of long hairs on labrum and poorly developed chaetotaxy on the anterior legs of the male may be peculiar to the present species. *Yanoi* is superficially resembling to *kuroiwae* Matsumura (= *batillifrons* Lundblad) but easily separated by the more distinct coloration of legs, larger size of the body, entirely grooved frons, a pair of tufts of long hairs on labrum, different structure of stridulatory comb, chaetotaxy on anterior legs, and others.

***Enithares martini* Kirkaldy (Fig. 25)**

SPECIMENS EXAMINED: 2 adults, 2 nymphs, Banaue, Ifugao, 27-31. vii. 1979.

DISTRIBUTION : Philippines\* (endemic).

This is the first record of this genus from the Philippine paddy water.

#### BELOSTOMATIDAE

***Lethocerus indicus* (Lepeletier et Serville)**

SPECIMENS EXAMINED: 5 nymphs, Tugbok, Davao City, 28-30. viii. 1979.

DISTRIBUTION : Philippines\*, Thailand\*, India, Sri Lanka\*, China, Taiwan, Java\*, Sumatra.

This species was formerly recorded from paddy water of Thailand. Pawar (1974) recorded this species from the Philippines based on the material collected at light in paddy fields.

#### CORIXIDAE

***Micronecta quadristrigata* Breddin (Fig. 26)**

SPECIMENS EXAMINED :: 1 adult, Tugbok, Davao City, 28-30. viii. 1979. 278 adults, 3 nymphs, Bislig, Surigao del Sur, 1-4. ix. 1979.

DISTRIBUTION : Philippines\*, Sri Lanka\*, India\*, Malaya, Sumatra\*, Java, Celebes, Viet Nam, Thailand, Hong Kong, Taiwan, Iran.

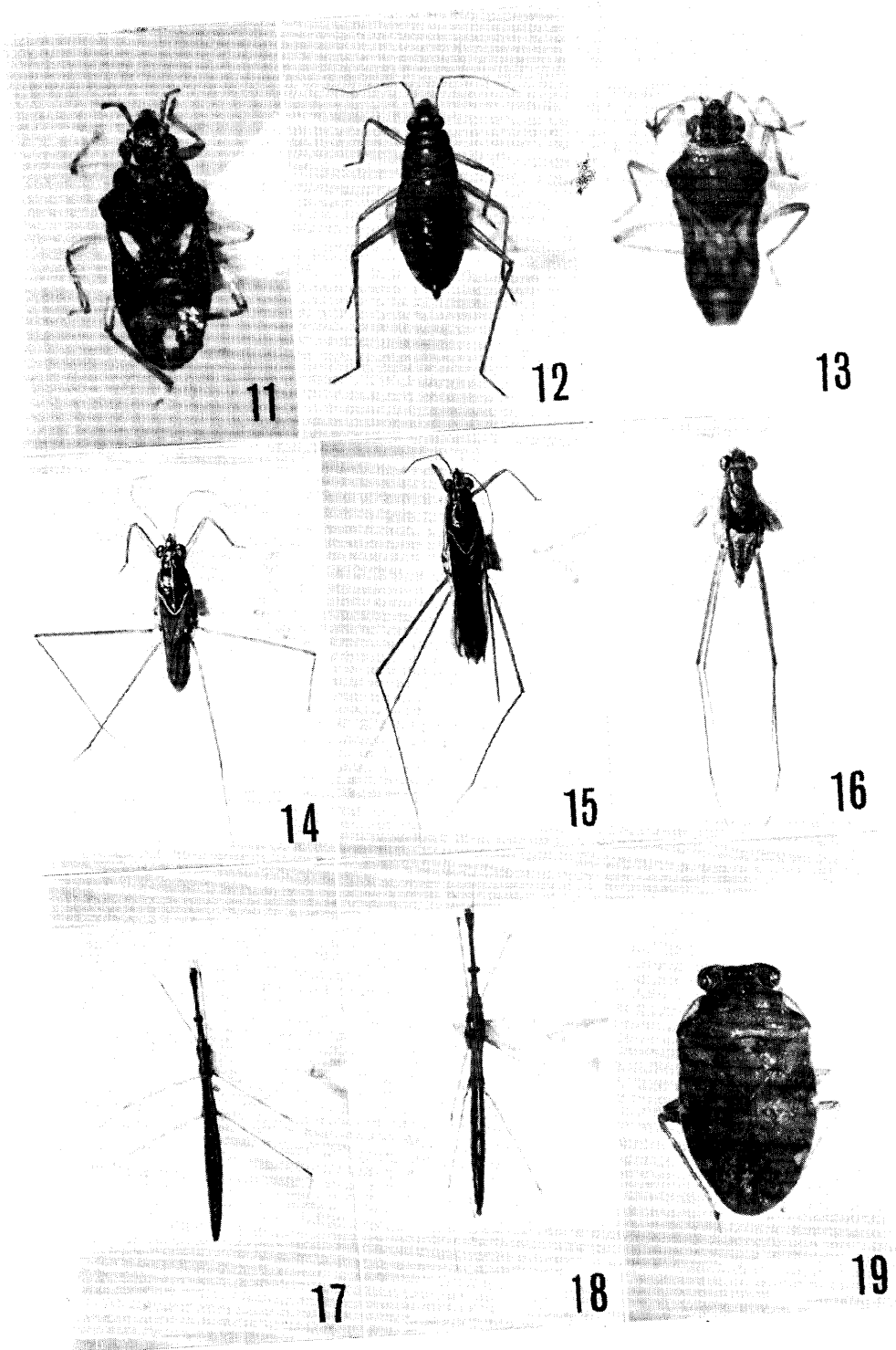
This species is probably one of the most widely distributed and common species of the Corixidae in S. E. Asian aquatic habitats as well as *Agraptocorixa hyalinipennis*. Many specimens of this species were collected at Bislig from a small amount of water. Thus, it seems probable that this species is tolerable to a high population density.

From the Philippines, 18 species and 4 unidentified species belonging to 11 families have been known from paddy fields previously (cf. Table 1). This figure, however, contains the records of Polhemus and Reisen (1976) who mixed the data from paddy and irrigation ditch. Present records add 9 species (*Saldoida armata*, *Hebrus bergrothi*, *Mesovelgia vittigera*, *Limnogonus nitidus*, *Limnogonus parvulus*, *Paraplea davaoensis*, *Anisops yanoi*, *Enithares martini* and *Lethocerus indicus*) and now total 27 species and 4 unidentified species of 12 families are known from the Philippine paddy water.

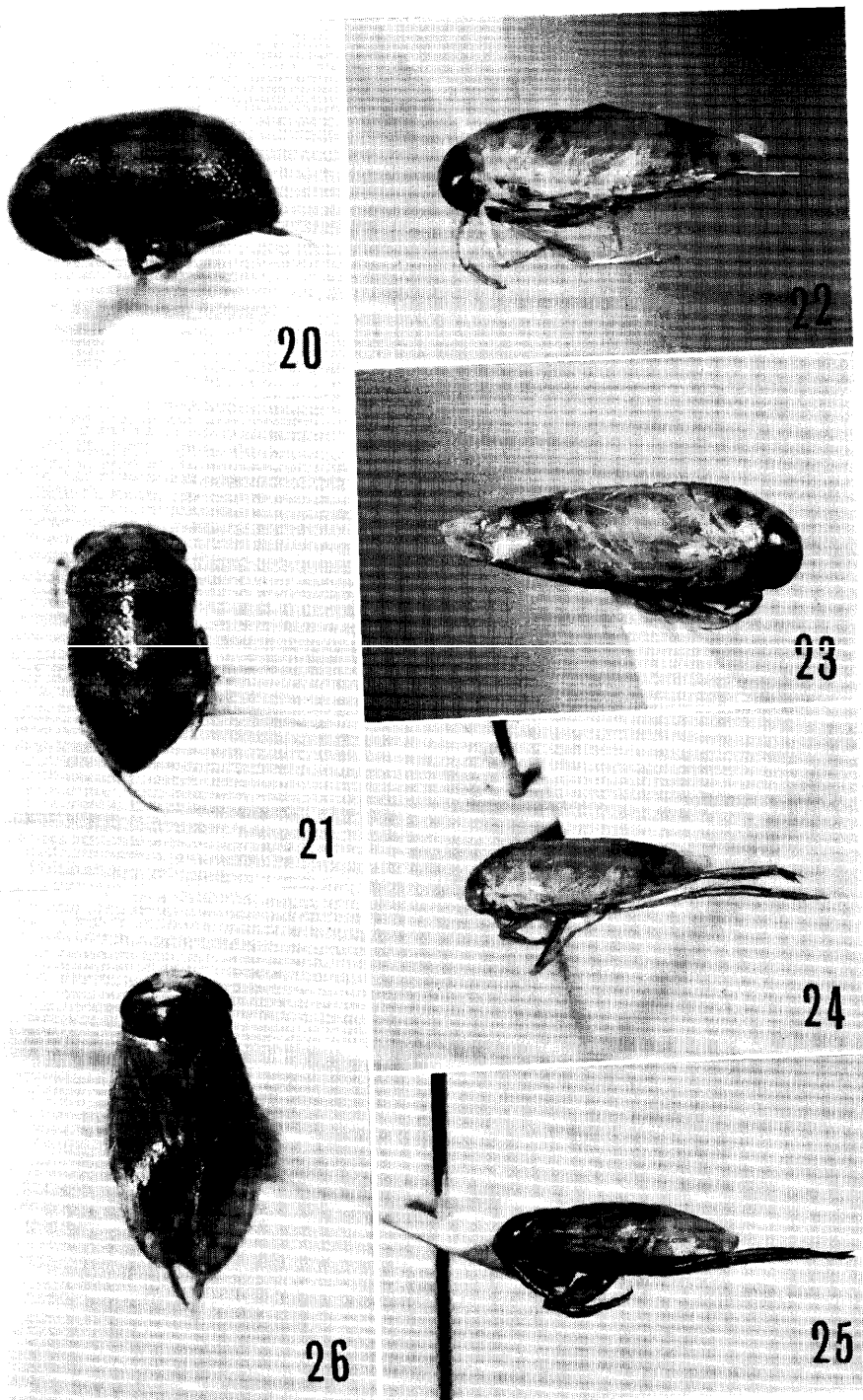
Some preliminary notes on the abundance of species concerned mentioned below are provided by the present knowledge which is certainly far from expected level. Following species seems to be major among the known species. They are *Microvelia douglasi atrolineata*, *Micronecta quadristrigata* and *Anisops kuroiwae*. *Mesovelgia vittigem*, *Limnogonus nitidus* and *Hydrometra lineata* may stand next.

Species of Naucoridae have not been recorded from the Philippine paddy water, though it is expected to be collected by the future surveys.

## AQUATIC AND SEMIAQUATIC HETEROPTERA FROM PHILIPPINES







## EXPLANATION OF FIGURES

11. *Hebrus bergrothi* Horváth. Banaue, Ifugao.
12. *Mesovelia vittigera* Horváth. Tugbok, Davao City.
13. *Microvelia douglasi atrolineata* Bergroth. Bay, Laguna.
14. *Limnogonus fossarum* (Fabricius). Banaue, Ifugao.
15. *Limnogonus nitidus* (Mayr). Tugbok, Davao City.
16. *Limnogonus parvulus* (Stål). Banaue, Ifugao.
17. *Hydrometra Zineata* Eschscholtz. Tugbok, Davao City.
18. *Hydrometra orientalis* Lundblad. Tugbok, Davao City.
19. *Ochterus marginatus* (Latreille). Pila, Laguna.
20. *Paraplea davaoensis* Miyamoto, sp. nov. Holotype, female. Tugbok, Davao City.
21. Ditto, dorsal view.
22. *Anisops kuroiwae* Matsumura. Bislig, Surigao del Sur.
23. *Anisops nodulata* Brooks. Banaue, Ifugao.
24. *Anisops yanoi* Miyamoto, sp. nov. Paratype, female. Banaue, Ifugao.
25. *Enithares martini* Kirkaldy. Banaue, Ifugao.
26. *Micronecta quadristrigata* Breddin. Bislig, Surigao del Sur.

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### Addendum

We overlooked the record of the following subspecies from paddy water.

#### Gerridae

*Gerris (Aquarius) paludumamamiensis* Miyamoto

1 ♀, Ishigaki I., Nansei Is., Japan. (Miyamoto, 1964b)